

PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶: A61K 31/35, 31/70	A2	(11) International Publication Number: WO 98/00130 (43) International Publication Date: 8 January 1998 (08.01.98)
(21) International Application Number: PCT/US97/10953 (22) International Filing Date: 23 June 1997 (23.06.97) (30) Priority Data: 60/022,004 28 June 1996 (28.06.96) US (71) Applicant: ORTHO PHARMACEUTICAL CORPORATION [US/US]; U.S. Route #202, P.O. Box 300, Raritan, NJ 08869-0602 (US). (72) Inventor: SHANK, Richard, P.; 551 Village Circle, Blue Bell, PA 19422-1636 (US). (74) Agents: CIAMPORCERO, Audley, A., Jr. et al.; Johnson & Johnson, One Johnson & Johnson Plaza, New Brunswick, NJ 08933-7003 (US).	(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>Without international search report and to be republished upon receipt of that report.</i>	
(54) Title: ANTICONVULSANT SULFAMATE DERIVATIVES USEFUL IN TREATING OBESITY (57) Abstract Anticonvulsant derivatives useful in treating obesity are disclosed.		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

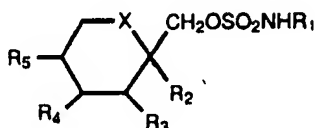
AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LJ	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

ANTICONVULSANT SULFAMATE DERIVATIVES USEFUL IN TREATING OBESITY

BACKGROUND OF THE INVENTION

5

Compounds of Formula I:



- 10 are structurally novel antiepileptic compounds that are highly effective anticonvulsants in animal tests (Maryanoff, B.E., Nortey, S.O., Gardocki, J.F., Shank, R.P. and Dodgson, S.P. *J. Med. Chem.* 30, 880-887, 1987; Maryanoff, B.E., Costanzo, M.J., Shank, R.P., Schupsky, J.J., Ortegon, M.E., and Vaught J.L. *Bioorganic & Medicinal Chemistry Letters* 3, 2653-2656, 1993, McComsey, D. F. and Maryanoff B. E., *J. Org. Chem.* 59, 2652 Chem. 1995). These compounds are covered by US Patent No. 4,513,006. One of these compounds 2,3:4,5-bis-O-(1-methylethylidene)-β-D-fructopyranose sulfamate known as topiramate has been demonstrated in clinical trials of human epilepsy to be effective as adjunctive therapy or as monotherapy in treating simple and complex partial seizures and secondarily generalized seizures (E. FAUGHT, B.J. WILDER, R.E. RAMSEY, R.A. REIFE, L D. KRAMER, G.W. PLEDGER, R.M. KARIM et. al., *Epilepsia* 36 (S4) 33, 1995; S.K. SACHDEO, R.C. SACHDEO, R.A. REIFE, P. LIM and G. PLEDGER, *Epilepsia* 36 (S4) 33, 1995), and is currently marketed for the treatment of simple and complex partial seizure epilepsy with or without secondary generalized seizures in Great Britain, Finland, the United States and Sweden and applications for regulatory approval are presently pending in numerous countries throughout the world.

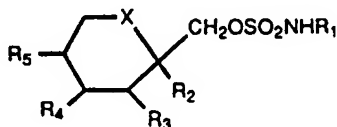
- 30 Compounds of Formula I were initially found to possess anticonvulsant activity in the traditional maximal electroshock seizure (MES) test in mice

(SHANK, R.P., GARDOCKI, J.F., VAUGHT, J.L., DAVIS, C.B., SCHUPSKY, J.J., RAFFA, R.B., DODGSON, S.J., NORTEY, S.O., and MARYANOFF, B.E., *Epilepsia* 35 450-460, 1994). Subsequent studies revealed that Compounds of Formula I were also highly effective in the MES test in rats. More recently topiramate was found to effectively block seizures in several rodent models of epilepsy (J. NAKAMURA, S. TAMURA, T. KANDA, A. ISHII, K. ISHIHARA, T. SERIKAWA, J. YAMADA, and M. SASA, *Eur. J. Pharmacol.* 254 83-89, 1994), and in an animal model of kindled epilepsy (A. WAUQUIER and S. ZHOU, *Epilepsy Res.* 24, 73-77, 1996).

Recent preclinical studies on topiramate have revealed previously unrecognized pharmacological properties which suggest that topiramate should be effective in treating obesity.

DISCLOSURE OF THE INVENTION

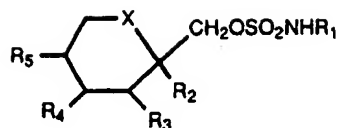
Accordingly, it has been found that compounds of the following formula I:



wherein X is O or CH₂, and R₁, R₂, R₃, R₄ and R₅ are as defined hereinafter are useful in treating obesity.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

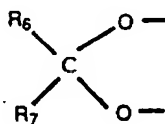
The sulfamates of the invention are of the following formula (I):



wherein

- 5 X is CH₂ or oxygen;
 R₁ is hydrogen or alkyl; and
 R₂, R₃, R₄ and R₅ are independently hydrogen or lower alkoxy, when X
 is oxygen, R₂ and R₃ and/or R₄ and R₅ together may be a methylenedioxy
 group of the following formula (II):

10



wherein

- R₆ and R₇ are the same or different and are hydrogen, lower alkyl or are
 15 alkyl and are joined to form a cyclopentyl or cyclohexyl ring.

 R₁ in particular is hydrogen or alkyl of about 1 to 4 carbons, such as
 methyl, ethyl and iso-propyl. Alkyl throughout this specification includes straight
 and branched chain alkyl. Alkyl groups for R₂, R₃, R₄, R₅, R₆ and R₇ are of
 about 1 to 3 carbons and include methyl, ethyl, iso-propyl and n-propyl.

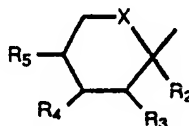
20

- A particular group of compounds of formula (I) are those wherein X is
 oxygen and both R₂ and R₃, and R₄ and R₅ together are methylenedioxy
 groups of the formula (II), wherein R₆ and R₇ are both hydrogen, both alkyl, or
 combine to form a spiro cyclopentyl or cyclohexyl ring, in particular where R₆
 25 and R₇ are both alkyl such as methyl. A second group of compounds are those
 wherein X is CH₂ and R₄ and R₅ are joined to form a benzene ring. A third

group of compounds of formula (I) are those wherein both R_2 and R_3 are hydrogen.

5 The compounds of formula (I) may be synthesized by the following methods:

(a) Reaction of an alcohol of the formula RCH_2OH with a chlorosulfamate of the formula $ClSO_2NH_2$ or $ClSO_2NHR_1$ in the presence of a base such as potassium *n*-butoxide or sodium hydride at a temperature of about
10 -20° to 25° C and in a solvent such as toluene, THF or dimethylformamide wherein R is a moiety of the following formula (III):



15 (b) Reaction of an alcohol of the formula RCH_2OH with sulfonyl chloride of the formula SO_2Cl_2 in the presence of a base such as triethylamine or pyridine at a temperature of about -40° to 25° C in a solvent such as diethyl ether or methylene chloride to produce a chlorosulfate of the
20 formula RCH_2OSO_2Cl .

The chlorosulfate of the formula RCH_2OSO_2Cl may then be reacted with an amine of the formula R_1NH_2 at a temperature of about 40° to 25° C in a solvent such as methylene chloride or acetonitrile to produce a compound of formula (I). The reaction conditions for (b) are also described by T. Tsuchiya et al. in Tet. Letters, No. 36, p. 3365 to 3368 (1978).
25

(c) Reaction of the chlorosulfate RCH_2OSO_2Cl with a metal azide such as sodium azide in a solvent such as methylene chloride or acetonitrile yields an azidosulfate of the formula $RCH_2OSO_2N_3$ as described by M.

Hedayatullah in Tet. Lett. p. 2455-2458 (1975). The azidosulfate is then reduced to a compound of formula (I) wherein R₁ is hydrogen by catalytic hydrogenation, e.g. with a noble metal and H₂ or by heating with copper metal in a solvent such as methanol.

5

The starting materials of the formula RCH₂OH may be obtained commercially or as known in the art. For example, starting materials of the formula RCH₂OH wherein both R₂ and R₃, and R₄ and R₅ are identical and are of the formula (II) may be obtained by the method of R. F. Brady in Carbohydrate Research, Vol. 14, p. 35 to 40 (1970) or by reaction of the trimethylsilyl enol ether of a R₆COR₇ ketone or aldehyde with fructose at a temperature of about 25° C, in a solvent such a halocarbon, e.g. methylene chloride in the presence of a protic acid such as hydrochloric acid or a Lewis Acid such as zinc chloride. The trimethylsilyl enol ether reaction is described by G. L. Larson et al in J. Org. Chem. Vol. 38, No. 22, p. 3935 (1973).

15

Further, carboxylic acids and aldehydes of the formulae RCOOH and RCHO may be reduced to compounds of the formula RCH₂OH by standard reduction techniques, e.g. reaction with lithium aluminum hydride, sodium borohydride or borane-THF complex in an inert solvent such a diglyme, THF or toluene at a temperature of about 0° to 100° C, e.g. as described by H.O. House in "Modern Synthetic Reactions", 2nd Ed., pages 45 to 144 (1972).

20

The compounds of formula I: may also be made by the process disclosed US Patent: No.4,513,006, which is incorporated by reference herein.

25

The compounds of formula I include the various individual isomers as well as the racemates thereof, e.g., the various alpha and beta attachments, i.e., below and above the plane of the drawing, of R₂, R₃, R₄ and R₅ on the 6-membered ring. Preferably, the oxygens of the methylenedioxy group (II) are attached on the same side of the 6-membered ring.

30

The activity of the compounds of formula I in treating obesity was first evidenced in several preclinical long term (three months to two years) studies. Topiramate caused a significant reduction in the rate of weight gain, or a weight loss in rodents and dogs at doses as low as 10 mg/kg p.o. Analysis of food consumption in these studies indicated that the effect of topiramate on body weight was due primarily to a decrease in metabolic efficiency rather than a decrease in food consumption. In clinical studies in which topiramate was administered to patients with epilepsy, a loss of body weight was a statistically significant side-effect.

For treating obesity, a compound of formula (I) may be employed at a daily dosage in the range of about 50 to 200 mg, usually in two divided doses, for an average adult human. A unit dose would contain about 25 to 100 mg of the active ingredient.

To prepare the pharmaceutical compositions of this invention, one or more sulfamate compounds of formula (I) are intimately admixed with a pharmaceutical carrier according to conventional pharmaceutical compounding techniques, which carrier may take a wide variety of forms depending on the form of preparation desired for administration, e.g., oral, by suppository, or parenteral. In preparing the compositions in oral dosage form, any of the usual pharmaceutical media may be employed. Thus, for liquid oral preparations, such as for example, suspensions, elixirs and solutions, suitable carriers and additives include water, glycols, oils, alcohols, flavoring agents, preservatives, coloring agents and the like; for solid oral preparations such as, for example, powders, capsules and tablets, suitable carriers and additives include starches, sugars, diluents, granulating agents, lubricants, binders, disintegrating agents and the like. Because of their ease in administration, tablets and capsules represent the most advantageous oral dosage unit form, in which case solid pharmaceutical carriers are obviously employed. If desired, tablets may be sugar coated or enteric coated by standard techniques. Suppositories may be

prepared, in which case cocoa butter could be used as the carrier. For parenterals, the carrier will usually comprise sterile water, though other ingredients, for example, for purposes such as aiding solubility or for preservation, may be included. Injectable suspensions may also be prepared

5 in which case appropriate liquid carriers, suspending agents and the like may be employed. Topiramate is currently available for oral administration in round tablets containing 25 mg, 100 mg or 200 mg of active agent. The tablets contain the following inactive ingredients: lactose hydrous, pregelatinized starch, microcrystalline cellulose, sodium starch glycolate, magnesium stearate,

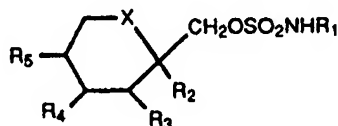
10 purified water, carnauba wax, hydroxypropyl methylcellulose, titanium dioxide, polyethylene glycol, synthetic iron oxide, and polysorbate 80.

The pharmaceutical compositions herein will contain, per dosage unit, e.g., tablet, capsule, powder injection, teaspoonful, suppository and the like

15 from about 25 to about 200 mg of the active ingredient.

WHAT IS CLAIMED IS:

1. A method for treating obesity comprising administering to a mammal afflicted with such condition a therapeutically effective amount for treating such condition of a compound of the formula I:



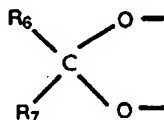
10 wherein

X is CH₂ or oxygen;

R₁ is hydrogen or alkyl; and

R₂, R₃, R₄ and R₅ are independently hydrogen or lower alkyl and, when

- 15 X is oxygen, R₂ and R₃ and/or R₄ and R₅ together may be a methylenedioxy group of the following formula (II):



20 wherein

R₆ and R₇ are the same or different and are hydrogen, lower alkyl or are alkyl and are joined to form a cyclopentyl or cyclohexyl ring.

2. The method of claim 1 wherein the compound of formula I is topiramate.
- 25 3. The method of claim 1, wherein the therapeutically effective amount is of from about 50 to 400 mg.

4. The method of claim 1, wherein the amount is of from about 25 to 200 mg.